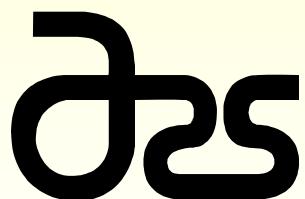




United States Department of Agriculture (USDA)
Agricultural Research Service (ARS)
1420 Experiment Station Road
Watkinsville Georgia 30677 USA
Tel: 1-706-769-5631
Email: alan.franzluebbers@ars.usda.gov

**Alan
Franzluebbers**
Ecologist



Recent Trends in Conservation Agriculture under Mediterranean Conditions

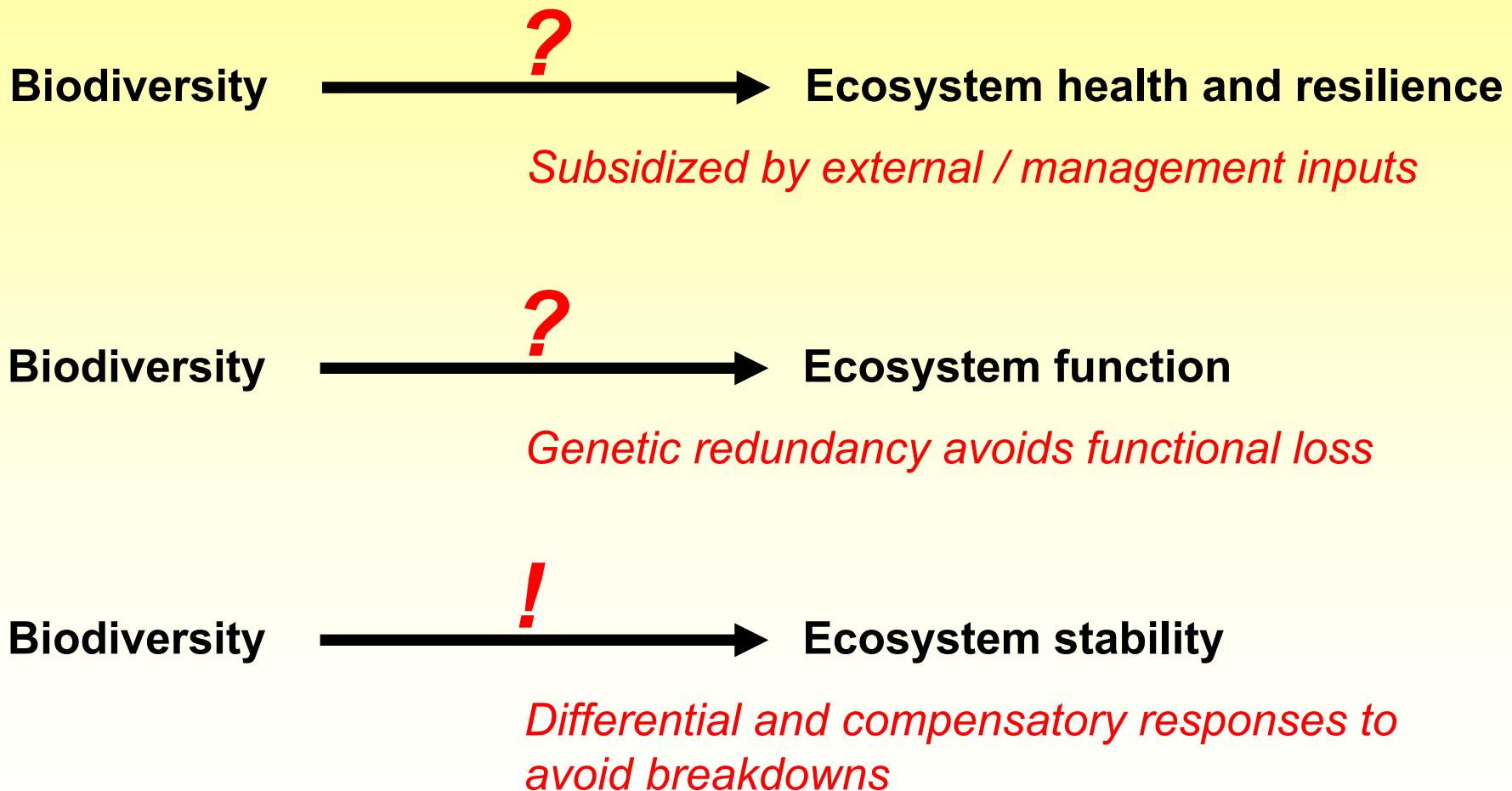
CIHEAM



Centre International de Hautes Études Agronomiques Méditerranéennes
International Centre for Advanced Mediterranean Agronomic Studies

Biodiversity

Role in ecosystems



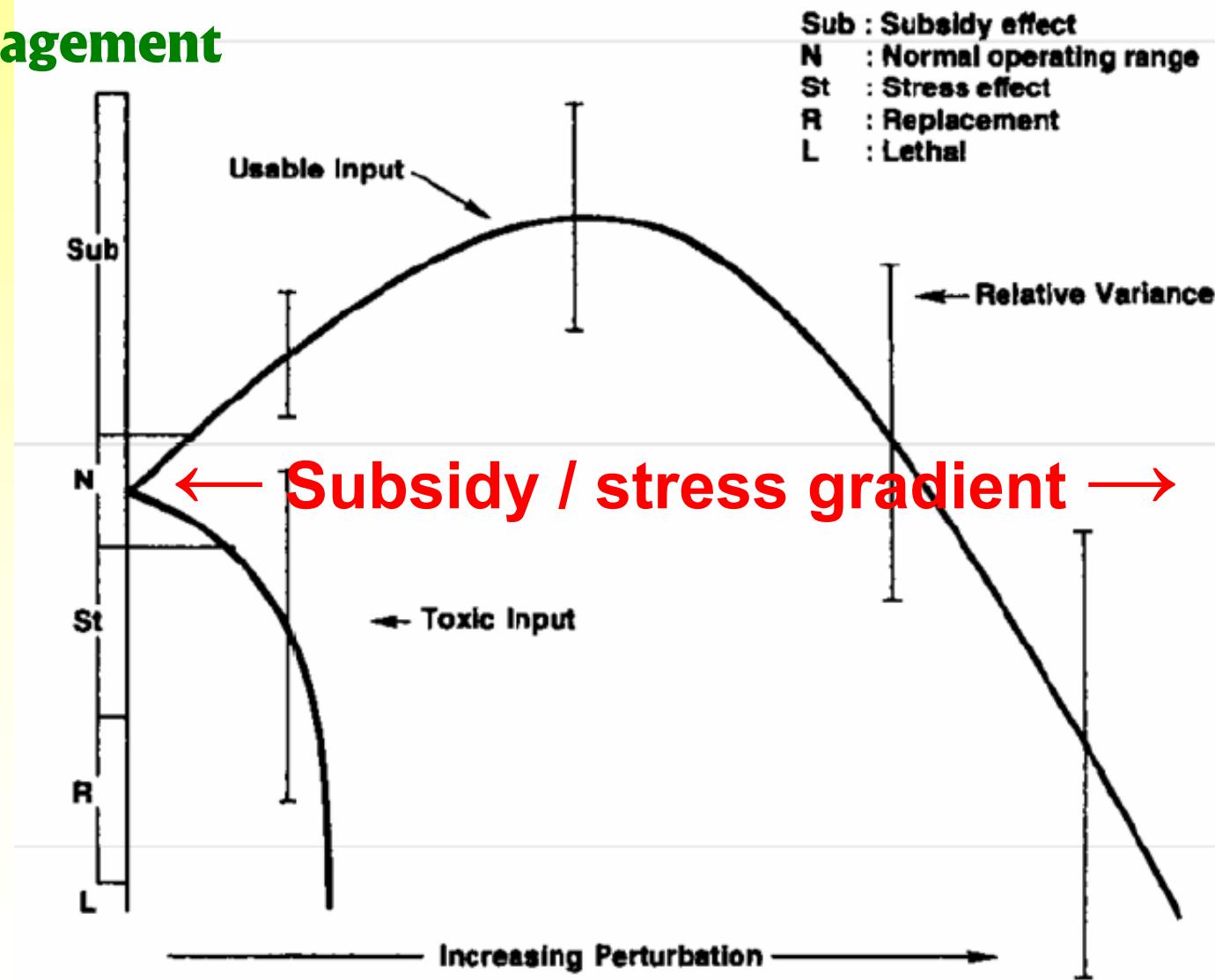
Biodiversity

Impact of management

Management can enrich or degrade the environment

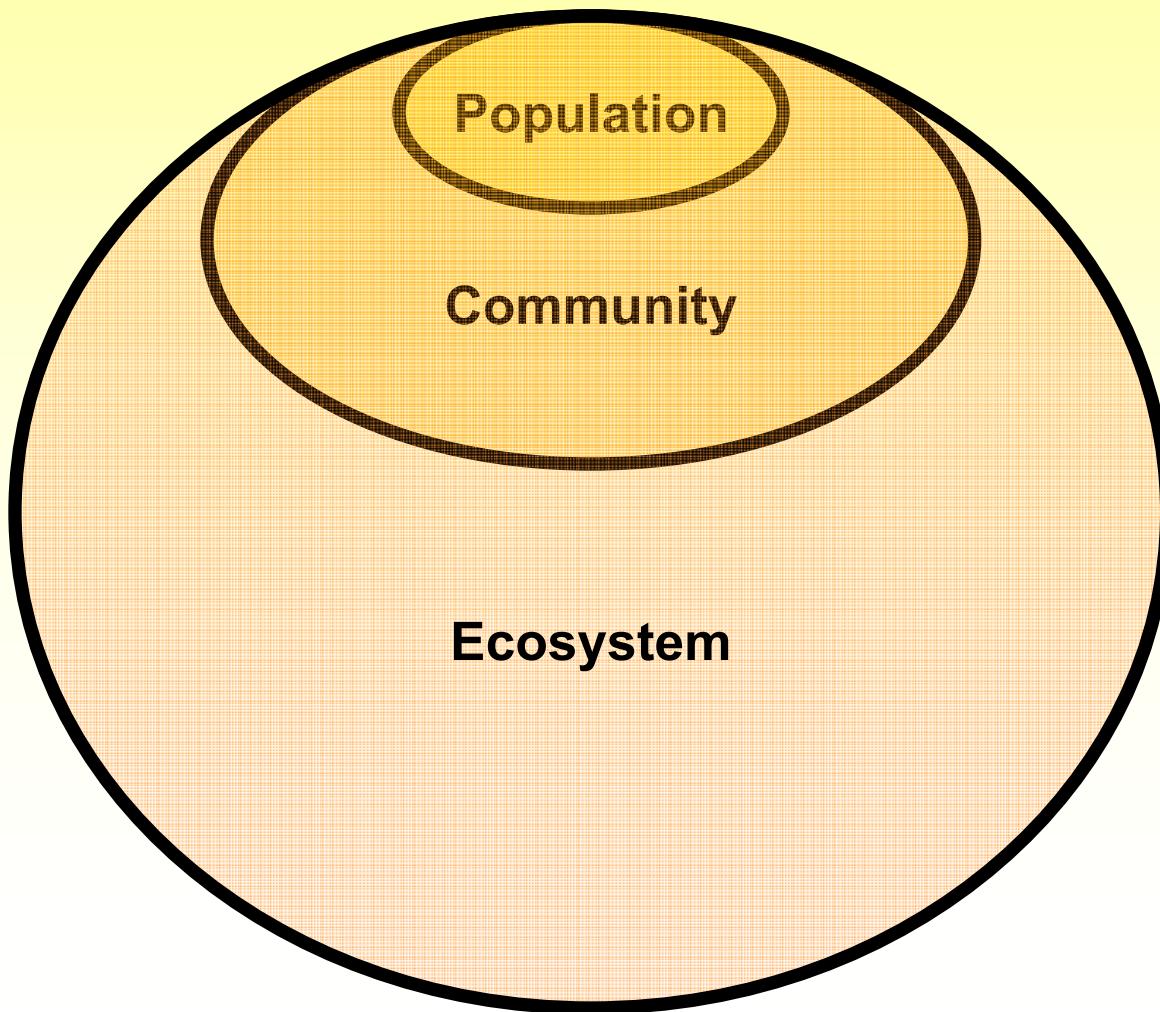
Perturbations may be

- **energy** (tillage, change in microclimate conditions, etc.)
- **C source** (type, frequency, placement, and quality of crop residues)
- **nutrients** (N, P, microelements, etc.)



Biodiversity

Level of organization



For example:

Predatory
ground beetle

Beneficial insects

Sustainable
agricultural
system

Evaluation with time



Biodiversity

Taxonomic versus functional diversity of crops

Number of different crops

Wheat – fallow

Wheat – sorghum – millet – fallow

Structural diversity of crops

Wheat – barley – oat – rye

Wheat – maize – oat – millet

Enhanced structural diversity of crops

Wheat – maize – oat – millet

Wheat / soybean – clover / maize

Functional diversity

Wheat – maize (grain only)

Wheat (grazed) – maize (grain)

Biodiversity

Spatial and temporal diversity of crops

Contour stripcropping

Wheat – fallow blocks

Narrow strips of wheat – fallow

Mixed intercropping

Wheat – fallow blocks

Wheat / clover intercrop – clover

Cover cropping

Wheat – sorghum – fallow

Wheat / lentil – clover / sorghum

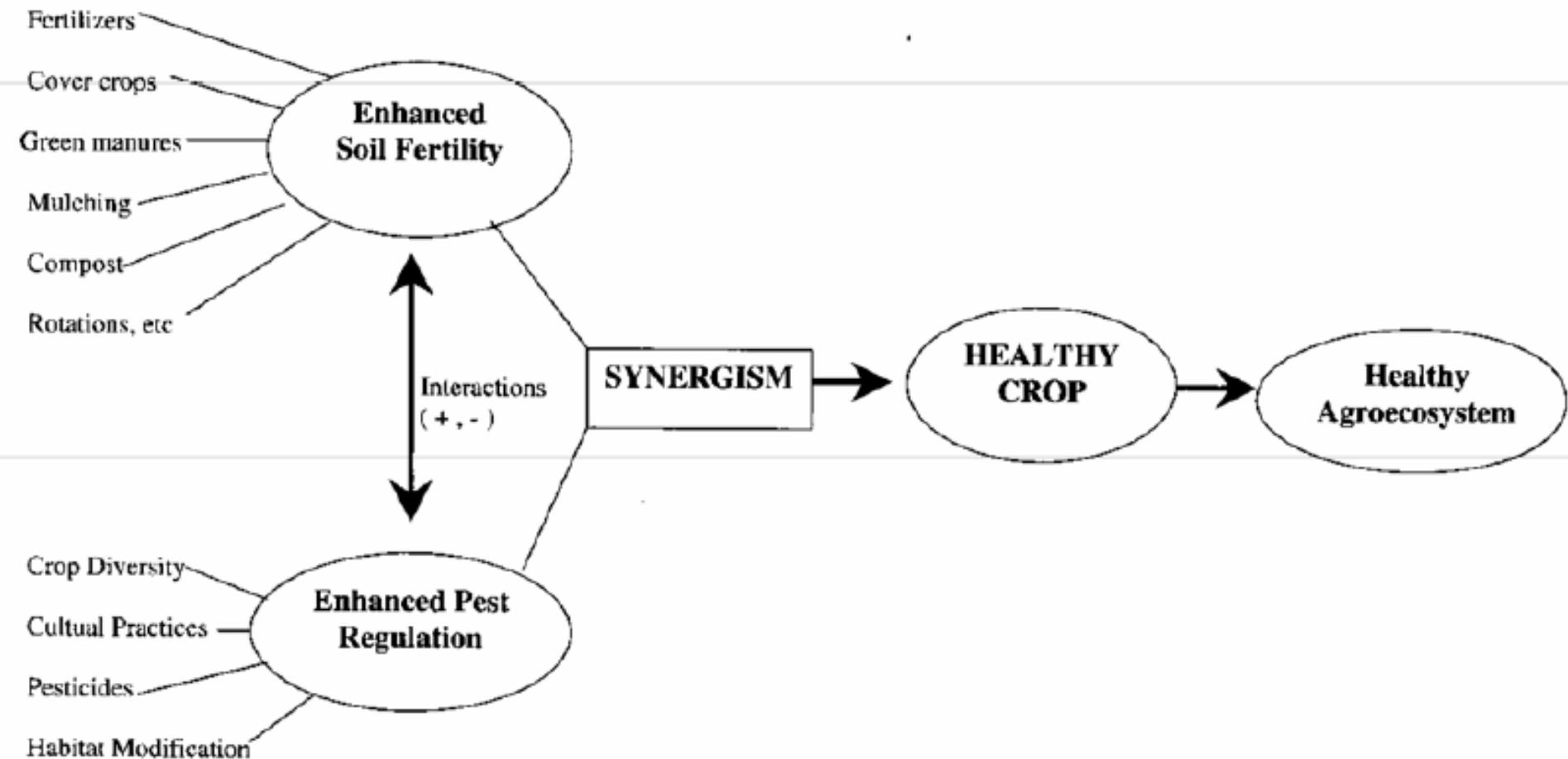
Integrated crop / livestock systems

Wheat – sorghum – fallow

Perennial pasture (grazed) – maize – clover (grazed) / cotton – rye (grazed) – millet (grain or grazed)

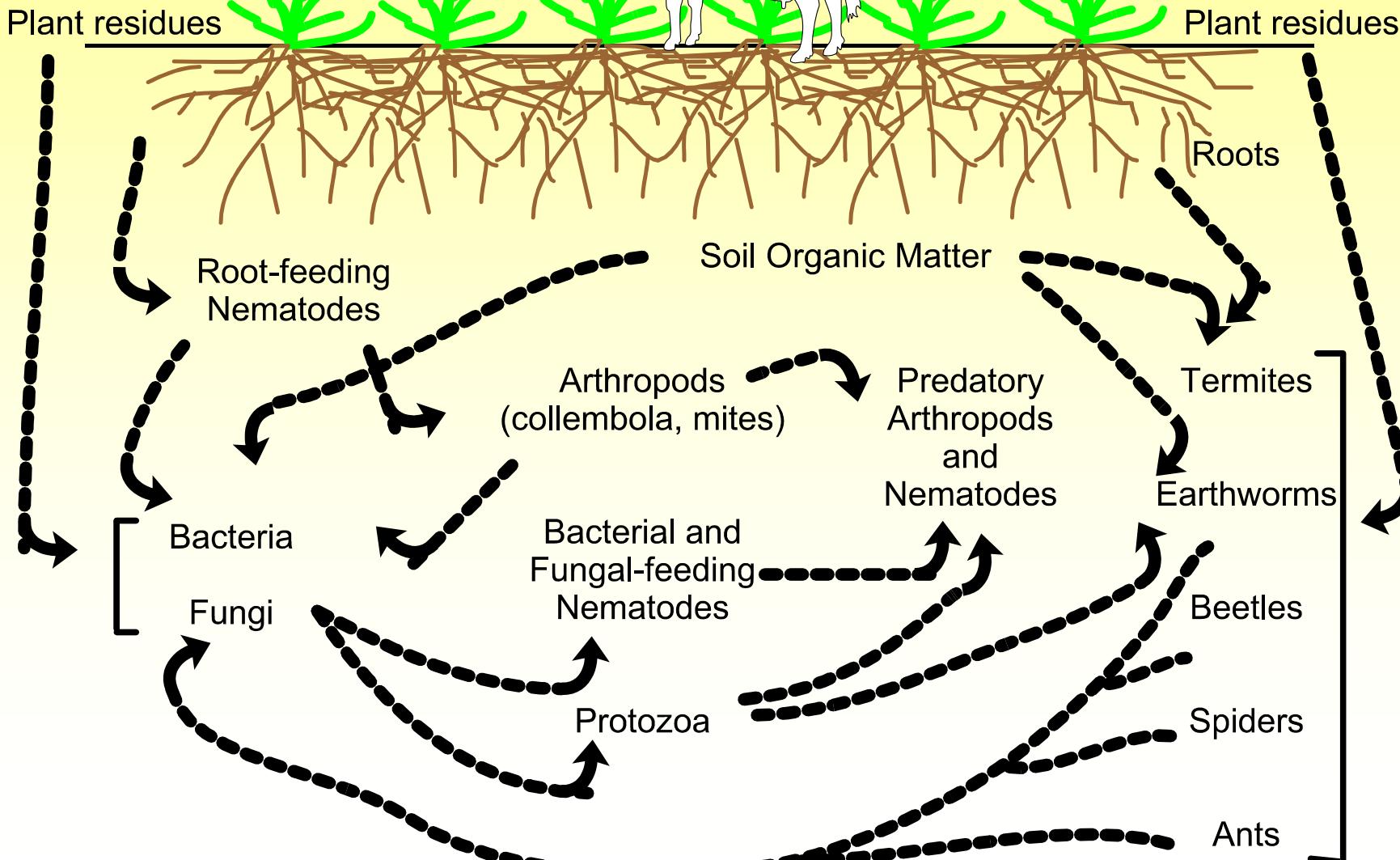
Biodiversity

Interdependence among agroecosystem components



Biodiversity

Level of organization



Biodiversity

Impact of tillage system

Arthropod group	Conventional tillage	No tillage
Soil microarthropods (no. / ha) (collembola, mites)	1000	< 380
Soil macroarthropods (no. / trap) (beetles, spiders)	5.4	5.3
Foliar arthropods (no. / trap) (corn rootworms, <i>Diabrotica</i>)	10.4	12.8
	0.9	0.8

Ohio
Wooster SiL
Typic Fragiudalf
20-yrs previously
Continuous corn

From Stinner et al. (1988) Soil Till. Res. 11:147-158

Biodiversity

Impact of tillage system

Arthropod group	Conventional tillage	No tillage
Araneae (spiders)	13	<<
Formicidae (ants)	22	<
Coleoptera (beetles)	14	23
Parasitoids (wasps)	6	<<
Collembola (springtails)	30	<
Diptera (flies)	15	<
Homoptera (hoppers)	15	12
Acarina (mites)	12	<

Huesca, Spain

CL

1-yr at 2 sites

Barley / maize

From Rodriguez et al. (2006) Soil Till. Res. 85:229-233

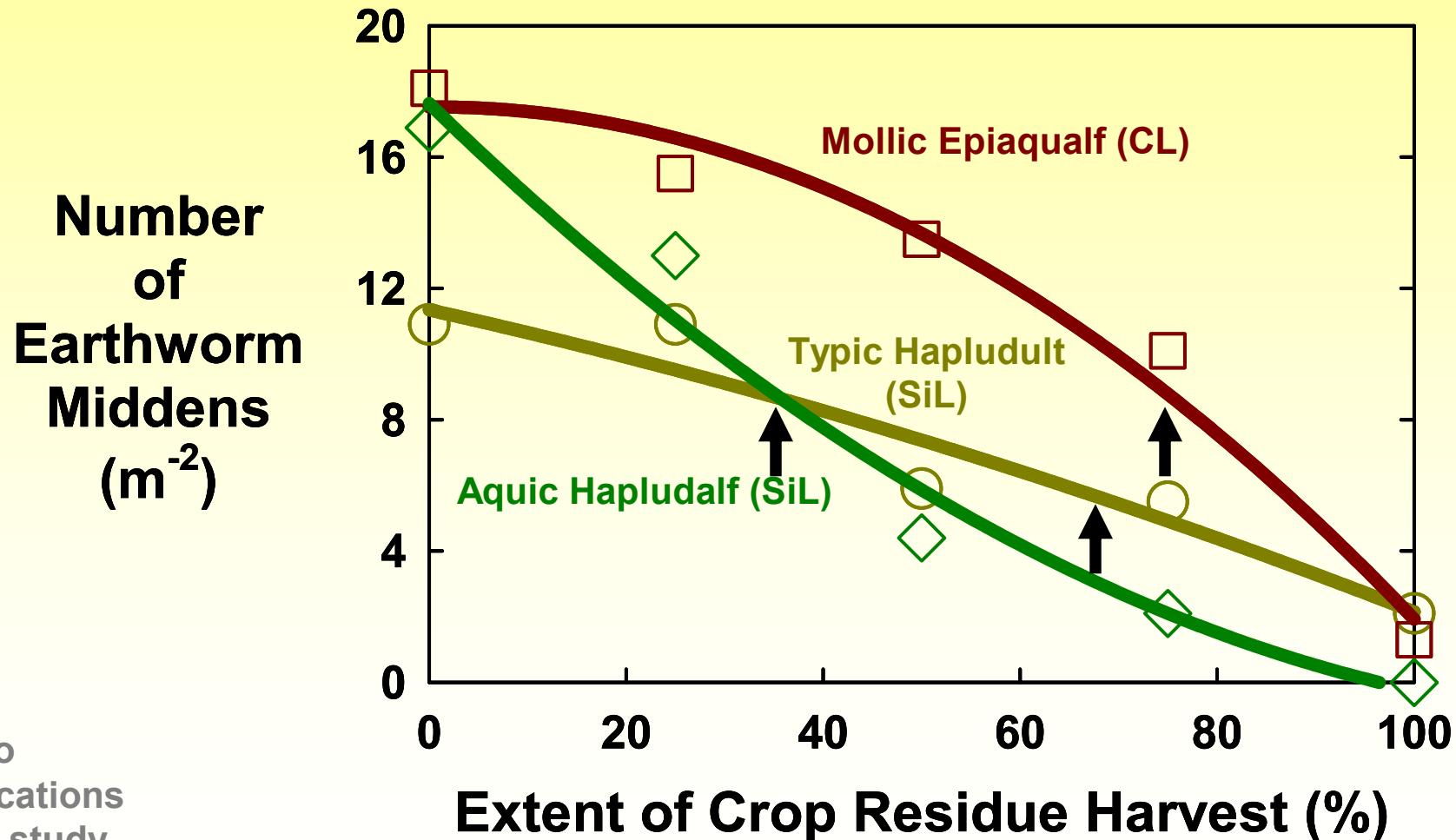
Biodiversity

Impact of crop residue

Location	Response	Soil	Residue removed	Residue retained	Source
Finland	Earthworms (no. m ⁻²)	Silty clay	1.2	2.0	Nuutinen (1992) Soil Tillage Res. 23:221-239
		Silty clay loam	1.7	1.7	
		Sandy loam	0.7	0.8	
New Zealand	?	Silt loam	243	323	Fraser & Piercy (1998) Applied Soil Ecol. 9:369-373
Wisconsin			53	78	
Denmark	Microbial C (mg kg ⁻¹)	Silt loam	330	696	Karlen et al. (1994) Soil Tillage Res. 31:149-167
		Loamy sand	151	184	
Mexico	Fungi (km g ⁻¹)	Sandy clay	324	364	Debosz et al. (1999) Applied Soil Ecol. 13:209-218
New Zealand		Silt loam	3.0	4.0	
					Cookson et al. (1998) Applied Soil Ecol. 7:179-188

Biodiversity

Impact of crop residue



Ohio
3 locations
1-yr study
Corn
No tillage

Data from Blanco-Canqui et al. (2007) Soil Tillage Res. 92:144-155

Biodiversity

Case study from Castro Verde Portugal

Government program to support habitat for steppic birds

www.dkiimages.com/discover/previews/748/272711.JPG



Great Bustard (*Otis tarda*)



<http://reddeparquesnacionales.mma.es/parques/cabaneros/fauna/img/82.jpg>

Little Bustard (*Tetrax tetrax*)



aym.juntaex.es/webs/dgma/web_primerilla/index.html

Lesser Kestrel
(*Falco naumannni*)

Open mosaic landscape with fields of cereals, stubble, plowed, and fallow
Program encourages crop rotations, long fallow, and no burning
Soil erosion a major concern not adequately addressed
Need soil conservation... From Marta-Pedroso et al. (2007) Soil Tillage Res. 97:79-90

Biodiversity

Summary

- ✓ **Conservation agricultural systems** can enhance above-ground and below-ground biodiversity by
 - Growing a wide range of crops with different structural and functional abilities
 - Reducing the need for pesticides with crop rotations
 - Creating spatial heterogeneity in the landscape with the use of perennial and annual crops (e.g. riparian zones, buffer zones, strip crops, etc.)
 - Enriching surface soil with organic matter and providing a suitable habitat for fauna and microorganisms